International Journal of Information Technology and Knowledge Management
July-December 2011, Volume 4, No. 2, pp. 413-415

A SURVEY OF CONGESTION CONTROL TECHNIQUES IN WIRELESS SENSOR NETWORKS

G.Srinivasan[1] & S.Murugappan[2]

In Wireless Sensor Networks (WSN) the packet loss occurs due to congestion. The sink node which is called special node collects information from other nodes. There are various congestion control algorithms are currently used. In WSN congestion detection and congestion control are the major research areas. It is important to design protocols for controlling congestion. The congestion control protocol is based on traffic, rate etc. It is important to control traffic rather than forwarding path. The noteworthy concept is to maintain queue length and link failure. The various congestion control and avoidance techniques will be discussed by analyzing various papers.

Keywords: Congestion, Traffic, Priority, Node, Protocol

1. Introduction

The fairness, efficiency and energy dissipation are used to determine the performance on WSN. There is various congestion control techniques used in wireless sensor networks. The I2MR [1] is one type of congestion control technique in which the shortest paths for load balancing achieved. The loading rate for source node can be adjusted. In sensor networks two types of traffic occur named as upstream traffic and downstream traffic. The wireless sensor network consists thousands of nodes. They are split into various subnets. Each subnet consist sensor node. All data collected from sensor nodes are routed to sink node. In upstream type the traffic is directed from sink node to source node. In CoSMoS [2] congestion control both the traffics were analyzed for mobile sink. In this paper we will analyze various congestion control techniques and algorithms for Wireless Sensor Networks.

2. Related Work

There are three techniques congestion detection, congestion control and congestion mitigation research areas in WSN. A study of congestion control is very useful for future research works. The priority based, heterogeneous network, rate based techniques will be discussed in this paper. Because of congestion the packet loss is an unavoidable problem WSN. So we are going to discuss how to mitigate congestion using various techniques and algorithms. The comparison also will be done for knowing which one is the best way for controlling congestion. The MAC protocol plays important role in networks because of the CSMA techniques are involved in this layer. Normally collision will occur if all packets or nodes are going to access the same medium. This is the major reason for creating collision. There by in order to avoid collision we have to design the protocol for the particular network. The rate adjustment is also very important to avoid the collision in Wireless Sensor Networks.

[1]Asst. Prof.,Dept. of Computer Sc. & Engg, MNM Jain Engineering College, INDIA
[2]Asst.Prof.,Dept. of Computer Sc. & Engg, DDE Study Centre, Annamalai University, INDIA
E-mail: [1]Srinivasan_2010@hotmail.com, [2]drmryes@gmail.com

3. Mitigation of Congestion

Wireless Sensor Networks contain various tiny sensor nodes which are connected to a special node called sink node. The main purpose of the nodes are taking measurement and converting them into signals, for example measuring some temperature, pressure etc. These signals are transformed into a distinct node called sink node. There are two main traffics in WSN named as upstream traffic and downstream traffic. The upstream traffic is many to one whereas the downstream traffic is one to many. The traffic from sensor nodes to sink node is called upstream traffic. The traffic from sink node to sensor nodes is called downstream. The congestion occurs in node level as well as link level. The TCP and DCCP [3] congestion control algorithm is based on sliding window protocol. In this algorithm the window of packets are being sent within the current window. The valid acknowledgements are identified depends on the window size.

3.1. Congestion in Node Level

The node level congestion occurs when the access the same transmission media. In Rate Adjustment Technique [4] algorithm the scheduling rate and source rate in single-path routing were explained in detail. Normally high congestion occurs in upstream traffic because it is many to one principle. In CAR [5] protocol the packets are routed based on priority. Depend on the priority the packets are routed in a special zone (or) out of that zone using CAR protocol.

3.2 Upstream Congestion Control

The upstream congestion control is classified as three types names as event-based, continues and hybrid. In event based the sensor node reports to sink node based on event. In query based type the sensor nodes are asked query y sink node. In continues type the sensor nodes periodically reports to sink node. In case of hybrid approach all three types included. The HCCP [6] is used to control congestion in WSN based on buffer size. In Fig 1 the node level congestion is illustrated clearly. The PSFQ [7] is used to analyze reliable data transport in WSN. In this approach if the neighbor nodes forward same packet it stops forwarding. It maintains cache table for maintain unknown packet details. The input rate, forwarding rate and scheduling rate are considered for congestion control. There are two types of traffic in WSN called transit and source. The source traffic occurs in sensor nodes whereas the transit traffic occurs in other nodes. All these traffics are entered into network layer.

4. CONGESTION CONTROL IN NODE LEVEL

It is important to design MAC layer properly to avoid queue formation. The network management of sink node affects the other nodes. In spite of various congestion control algorithms are used it is important to design the protocol. In Dynamic Contention Window Control [8] the buffer overflow is controlled by identifying highly loaded nodes. The efficiency, fairness and energy dissipation should be calculated properly. In order to get high efficiency the number of hops should be high than number of transmissions. Our motivation is to avoid packet loss and buffer drops by designing proper congestion control techniques.

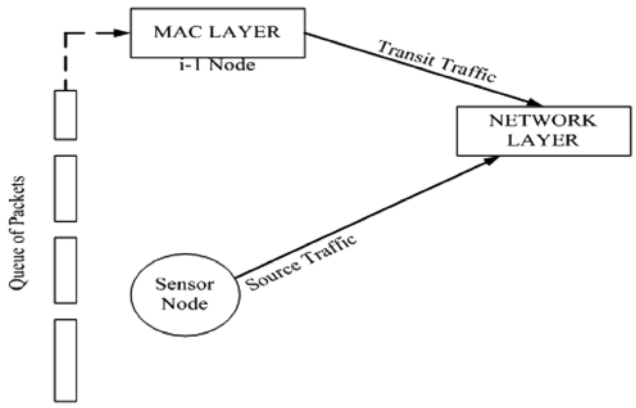

Fig.1: Node Level Traffic

4.1 Efficient Techniques for Congestion Control

In Fusion [9] the rate limiting approach is used. This scheme implies that how to propagate rates of each node. The token bucket system is applied for this technique. In PCCP [10] the congestion control is calculated using packet service time and packet inter arrival time. In this approach the rate adjustment is calculated based on priority. In CoSMoS [2] congestion control frame work the updating of sink and path is achieved by sending periodic advertisement to its neighbors. The transmission and retransmissions should be considered for downstream nodes. Fig 2 illustrates the table update of sink node.

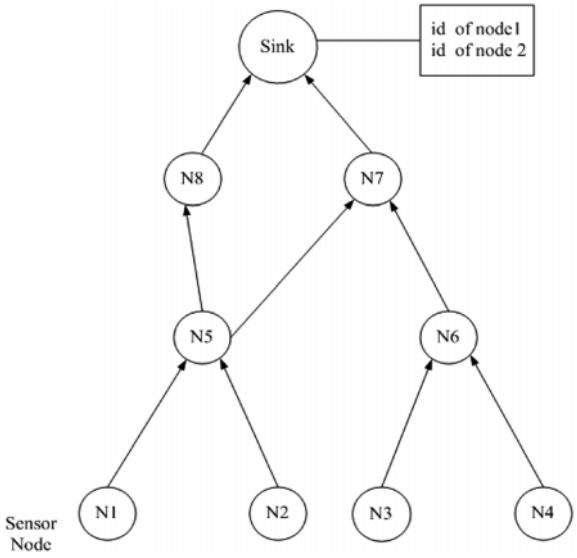

Fig. 2: Updating Sink Details

5. CONCLUSIONS AND FUTURE WORK

In this paper the various congestion control techniques were discussed in detail. The various algorithms and concepts were analyzed for congestion control in WSN. It is important to design proper way for creating new congestion control techniques for node level and link level. The CR [11] is one of the efficient methods for avoiding congestion using upstream and downstream traffics of neighbors. In ACT [12] the packet reduction method is applied using various compression techniques. In future we can create a new technique based on sink updates and sink advertisements. Also we can design a new technique for handling unknown and repeated packets. Based on the sink update table we can identify the congestion free zones and then forwarding packets to that zone. The various rate based techniques are also efficient for congestion control. The priority, rate adjustment and mobile sink may be considered as research areas for future work.

REFERENCES

[1] Jenn-Yue Teo, Yajun Ha, and Chen-Khong Tham, "Interference-Minimized Multipath Routing with Congestion Control in Wireless Sensor Network for High-Rate Streaming", IEEE Transactions on Mobile Computing, 7, No. 9, September 2008

[2] Kyriakos Karenos, and Vana Kalogeraki,"Traffic Management in Sensor Networks with a Mobile Sink

Member", IEEE Transactions On Parallel And Distributed Systems, Vol. 21, No. 10, October 2010

[3] Yong-Min Liu1,2, Xin-Hua Jiang1, Xiao-Hong Nian1, Wu-Yi Lu1, "Improved DCCP Congestion Control for Wireless Sensor Networks", 2009 Eighth IEEE/ACIS International Conference on Computer and Information Science, (IITA-2006-(C1090-0602-0002))

[4] R.Then Malar, "Congestion Control in Wireless Sensor Networks Based Multi-Path Routing In Priority Rate Adjustment Technique", Published in International Journal of Advanced Engineering & Applications, Jan. 2010

[5] N. Sengottaiyan, Rm.Somasundaram, S. Arumugam, "A Modified Routing Algorithm for Reducing Congestion in Wireless Sensor Networks", European Journal of Scientific Research, ISSN 1450-216X Vol.35 No.4 (2009), pp.529-536.

[6] JANG-PING SHEU1,2, LI-JEN CHANG2 AND WEI-KAI HU2, "Hybrid Congestion Control Protocol in Wireless Sensor Networks", Journal Of Information Science And Engineering 25, 1103-1119 (2009)

[7] Qixiang Pang, Vincent W.S. Wong and Victor C.M. Leung, "Reliable Data Transport and Congestion Control in Wireless Sensor Networks", Int. J. Sensor Networks, 3, No. 1, 2008

[8] Md. Mamun-Or-Rashid and Choong Seon Hong, "Dynamic Contention Window Based Congestion Control and Fair Event Detection in Wireless Sensor Network".

[9] Hull, B., Jamieson, K., and Balakrishnan, H. Mitigating "Congestion in Wireless Sensor Networks", In Proceedings of ACM SenSys, 3-5 November 2004, 134-147

[10] Chonggang Wang1, Kazem Sohraby1, Victor Lawrence2, Bo Li3, Yueming Hu4, "Priority-based Congestion Control in Wireless Sensor Networks", Proceedings of the IEEE International Conference on Sensor Networks, Ubiquitous, and Trustworthy Computing (SUTC'06) 0-7695-2553-9/06 $20.00 © 2006 IEEE

[11] Mohammad Z. Ahmad and Damla Turgut, "Congestion Avoidance and Fairness in Wireless Sensor Networks", Published in the IEEE "GLOBECOM" 2008 proceedings.

[12] Joa-Hyoung Lee and In-Bum Jung, "Adaptive-Compression Based Congestion Control Technique for Wireless Sensor Networks", Published in Sensors 2010, 29 March 2010.